Project Ukko: Seasonal wind speed predictions at a glance

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About Project Ukko & EUPORIAS

Project Ukko is a Barcelona Supercomputing Center and Future Everything prototype for the project EUPORIAS. It presents a novel way to spot patterns in seasonal wind prediction data. Understanding future wind conditions can become a crucial component in supporting clean energy sources and climate change resilience.

In Project Ukko, we put special emphasis on the challenge of **effectively communicating probabilistic prediction values** to decision-makers. We designed a novel visual device that helps informing the development of a coherent visual language for the project.

EUPORIAS is a 4-year collaborative project funded through the 7th FP, involving 24 institutions across Europe and led by the UK Met Office. The project is at the forefront of global efforts to develop **climate services**. It develops fully working prototypes of climate services that provide seasonal climate predictions tailored to the specific requirements of different users.

Potential users

- **Energy producers:** resource management strategies

- **Energy traders:** resource effects on markets

- **Wind farm operators**: planning for maintenance works

- **Wind farm investors:** optimize return on investments

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① Selected geographical area

② High probability of reduced wind speeds compared to climatology in the predicted season, displayed by blue lines pointing bottom right

③ High probability of increased wind speeds compared to climatology in the predicted season, displayed by yellow lines pointing top right

④ Seasonal average wind speed in the selected geographical region over the last 30 years based on ERA-Interim. Observations are split into three categories of equal size (terciles). The third of years with the highest wind speed (upper tercile) is marked in yellow and the third of years with the lowest wind speed (lower tercile) is marked in blue

⑤ Median wind speed of ERA-Interim over the past 30 years based on ERA-Interim

⑥ Wind prediction for the next season. Overall, 51 different ensemble members were generated, resulting in a range of potential outcomes. The percentage of simulations in each of the terciles gives the probability for the next season to have lower, equal or higher than normal wind speed conditions

⑦ The skill measures how well the prediction system has performed over the last 30 years in the selected region. It informs the expected performance of the forecasts in the future. A skill of 100% would mean that the prediction system performance is perfect, whereas a skill of 0% means that our model is not better than making a guess based on historical data. Prediction skill is expressed through opacity in the map. Regions with higher skill values are more opaque, and regions with lower skill values are more transparent

⑧ Currently installed wind power in the selected region, which reflects the production capacity in that particular area. Turbine icons of varying size show the overall installed power (generously provided by windpower.net)

⑨ The line thickness is directly proportional to the median predicted wind speed

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Seasonal wind speed predictions

What are they?

Seasonal wind predictions provide information of how likely it is that the coming season will be less, equal or more windy than normal. Project Ukko uses 10-m wind speed forecasts from the ECMWF Forecast Prediction System 4[1]. The operational System 4 forecasts are produced at the beginning of each month with 51 ensemble members, which use slightly different initial conditions.

Post-processing

Given the sparsity of global wind observations, the ERA-Interim global reanalysis is used for validation as the best available estimate of wind. Seasonal predictions require bias correction in order to statistically resemble the observational reference and minimize forecast errors[2]. The quality of predictions is assessed by comparing predicted values with the "observations" provided by the reanalysis. A skill score is calculated to evaluate if the model provides better information than climatology.

Probabilistic predictions

In Project Ukko, the percentage of probability that wind speed will be lower, equal and higher than normal is calculated, and the most probable category of wind speed is indicated according to the obtained results. Seasonal wind predictions are probabilistic in nature, meaning that they give the probability of occurrence of certain outcomes rather than a single 'yes-no' prediction. This information is crucial in order to know how useful they are to support decision-making in the wind energy sector[3].

1. Molteni et al. (2011) The new ECMWF seasonal forecast system (System 4), ECMWF

2. Doblas-Reyes et al. (2005), *Tellus A 57: 234-252*

3. Weisheimer & Palmer (2014), *Journal of the Royal Society Interface 11:20131162*

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